PB-217 077

PRELIMINARY INVESTIGATION OF KRAFT MILL WASTES, CORSSETT PAPER MILLS, CROSSETT, ARKANSAS AS RELATED TO OUACHITA RIVER POLLUTION IN VICINITY OF ARKANSAS-LOUISIANA STATE LINE

Hayse H. Black

Environmental Health Center
Cincinnati, Ohio

June 1949

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June, 1949

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Environmental Health Center

Cincinnati, Ohio

June, 1949

Preliminary investigation of Kraft Mill Wastes, Crossett Paper Mills, Crossett, Arkansas as related to Ouachita River Pollution in Vicinity of Arkansas-Louisiana State Line

By

Hayse H. Black, Sanitary Engineer
Chief, Industrial Waste Section

I

TABLE OF CONTENTS

		Page
General Information		
1.	Conference Dates	1
2.	Personnel Participating	1
3.	Purpose	1
4.	Complaints	1
5.	Maps of Area	2
6.	Pollution Sources	2
7.	Previous Investigations	2-3
8.	Testimonials	3
9.	Crossett Lumber Company	3-4
Crossett Paper Mills		
10.	Plant Description	4-5
11.	Raw Materials	5
12.	Products	5
13.	Production	5-6
14.	Operations	6
15.	Employees	6
16.	Water Supply	6
17.	Black Liquor Recovery	6-7
18.	By-Products	7
19.	Residual Process Wastes	7-8
20.	Expansion Program	8
21.	Improvements Affecting Wastes	8-9
Wood Distillation Plant		
22.	Plant Description	9
23.	Raw Materials	10
24.	Products	10
25.	Production	10
26.	Water Supply	10
27.	Process Wastes	10
28.	Waste Disposal	10
Coffee Creek		
29.	General Description	10-11
30.	Data Reported	11
31.	Mossy Lake	12

TABLE OF CONTENTS
(Continued)

		Page
Ouachita River		
32.	Drainage Area	12
33.	Gaging Station	12
34.	Minimum Flow	12-13
35.	Proposed Dams	13
36.	Natural Purification Studies Proposed	13
Kraft Mills Waste Treatment		
37.	Research by National Council	13-14-15-16
Summary		16
Appendices		
A.	Participants at March 30 Conference	17-18
B-1.	Letter Complaint June 17, 1948	19
B-2.	Letter Complaint October 4, 1948	20
C-1.	Map - Coffee Creek Drainage	21
C-2.	Map - Felsenthal Quadrangle	22
C-3.	Map - Haile Quadrangle	23
D-1.	Corps of Engineers Letter, November 19,1948	24
D-2.	Corps of Engineers Third End. September 30, 1944	25-26
D-3.	Corps of Engineers Third End. June 16, 1945	27
E.	Summary of Testimonials	28-29-30
F.	Crossett Paper Mills - Letter Report April 4, 1949	31-32-33
G-1.	Ouachita River Daily Low Flows at Cold Spring Bar, Arkansas	34-35
G-2.	Ouachita River Daily Low Flows at Monroe, Louisiana	36-37

PRELIMINARY INVESTIGATION OF KRAFT MILL WASTES, CROSSETT PAPER MILLS, CROSSETT, ARKANSAS As Related to OUACHITA RIVER POLLUTION IN VICINITY OF ARKANSAS-LOUISIANA STATE LINE

Major destruction of fish has been reported in Ouachita River just below the Arkansas-Louisiana state line, on numerous occasions, during the past several years. These fish kills have been attributed to pollution resulting from promiscuous discharge of process wastes from the sulfate pulp mill located at Crossett, Arkansas. This investigation was requested by the U. S. Public Health Service, Washington Office, in a memorandum dated February 11, 1949.

1. Conference Dates

March 30 and 31st, 1949

2. Personnel Participating

The names of men participating in this conference and the organization each represented are given in Appendix A.

3. Purpose

This meeting was scheduled by the Arkansas Game and Fish Commission February 22, 1949, letter directed to Crossett Paper Company, Crossett, Arkansas. The purpose of this meeting was to discuss process wastes created by operations of Crossett Paper Mills as they relate to pollution of Ouachita River.

4. Complaints

Harvey G. Fields, Attorney at Law, Farmersville, Louisiana, filed a letter complaint dated June 17, 1948, with the Secretary of War, War Department, Washington, D. C. A second letter dated October 4, 1948, from Mr. Fields, was directed to Commissioner Ernest S. Clements, New Orleans, Louisiana, with copies to the War Department, President Truman, Senator Ellender, and

Louisiana Stream Control Commission. Both letters alleged objectionable Ouachita River pollution attributed to operations of Crossett Paper Mills, Crossett, Ark. Copies of the letters referred to are included as Appendices B-1 and 2.

5. Maps of Area

Drainage from Crossett, Ark., is in a southwesterly direction, through a small stream known as Coffee Creek, which joins Ouachita River some 14 miles below Crossett. A map designated "Coffee Creek Drainage," prepared by Crossett Lumber Co., is included as Appendix C-1.

Topographic maps showing Ouachita River immediately above and directly below the Arkansas-Louisiana state line are appended as Appendices C-2 and C-3, respectively. Reference is made to the Felsenthal Quadrangle in Arkansas and the Haile Quadrangle in Louisiana.

6. Pollution Sources

Ouachita River receives wastes from sulphate pulp and paper mills located at Camden and Crossett, Ark.; Monroe and Bastrop, Louisiana. The Camden mill is located a considerable distance upstream from Crossett and the Ouachita River is in good sanitary condition at the point of confluence with Coffee Creek. Industrial waste discharge from the Monroe and Bastrop areas enters Ouachita River downstream from the section in which fish have been destroyed. These conditions point rather definitely to Crossett Paper Mills as the source of objectionable Ouachita River pollution.

7. Previous Investigations

Investigation was made of alleged Ouachita River pollution by the Corps of Engineers in September, 1944 and June, 1945. Reports on these investigations are contained in Third Endorsements to the Chief of Engineers

dated 30 September 1944 and 16 June 1945, which were transmitted to the Public Health Service by letter dated 19 November 1946. The letter referred to and the two endorsements which it transmitted are appended as Appendices D-1, D-2, D-3.

8. Testimonials

Arrangements were made by Attorney Fields, Farmersville, for interested citizens from Union Parish to present testimony before representatives of Arkansas State Board of Health, Arkansas Game & Fish Commission, Louisiana Stream Control Commission, and the U. S. Public Health Service, March 31, 1949. This meeting was held in the court room, Farmersville, Louisiana. Mr. Fields reported briefly on reports of Ouachita River pollution which had been brought to his attention. Seven local citizens, including some commercial fishermen, testified as to the destruction of fish which they had observed in Ouachita River near and upstream from Alabama Landing. It appears that the most recent major destruction of fish in Ouachita River below Crossett, Arkansas, occurred in late spring, 1948. The July 31, 1948, edition of the Monroe Morning World carried a story on the recent fish kill in Ouachita River at Alabama Landing. A summary of testimonials received at the Farmersville meeting March 31 is given in Appendix E.

9. Crossett Lumber Company

Crossett Lumber Co. dates from 1898, at which time the first blocks of short-leaf pine and hardwood timber were purchased in the Crossett, Ark., area. Initial interests were lumbering, with the first sawmill being placed in operation December 1, 1901. Currently the company operates two sawmill plants.

In the late 20's, a hardwood distillation plant was added, and in 1937

a Kraft paper mill was completed. Through selective cutting and reforestation practice, supervised by competent foresters, Crossett Lumber Company has become a self-perpetuating organization.

CROSSETT PAPER MILLS

10. Plant Description

This mill is located at the north west edge of the City of Crossett, Ark. It is a thoroughly modern sulfate paper mill, equipped to produce continuously various types of Kraft paper from southern pine by the sulfate process.

The sulfate pulp mill is of conventional design. Counter-current diffusers are employed for efficient heat recovery and for washing the cooked pulp. Chemicals are recovered from the spent cooking liquor (black liquor) by evaporation. Organic material is removed from the recovered chemicals by incineration in smelting furnaces. Evaporation is accomplished in a 5-body, quadruple-effect evaporator, followed by a cascade evaporator, the latter making use of exhaust steam from the turbines. The black liquor, with an average total solids concentration of 20 per cent, is concentrated in the multiple-effect evaporator to approximately 45 per cent solids, and further concentrated in the cascade evaporator to 55 per cent total solids. Concentrated black liquor is sprayed continuously into four furnaces. Molten chemical "smelt" is allowed to drain into a weak solution of "dissolving liquor" coming from the causticizing plant, producing the so-called green liquor. The green liquor is subsequently settled to remove insoluble impurities, causticized by adding slaked lime, and filtered to produce white liquor used in cooking of the wood. The white liquor or cooking liquor contains caustic soda, sodium sulfide, and small quantities of sodium carbonate, sodium sulfate, sodium sulfite, and thiosulfate.

A portion of the pulp produced is bleached by chlorine treatment. The

bleaching agent oxidizes and destroys the dyes formed from the tannins in the wood and accentuated by the sulfides present in the cooking liquor. The bleaching process tends to solubilize some of the pulp.

Equipment is provided for production of some log pulp. This pulp production is over and above the capacity of the present paper machines and is sold commercially. Log pulp as produced runs approximately 43 per cent total solids, or 57 per cent moisture.

The paper mill is equipped with two paper machines. The Fourdrinier machine has 196-inch trim and produces approximately 205 tons per day finished paper. The Fourdrinier machine is of latest design and can operate at speeds as high as 1500 feet per minute. The cylinder machine is of older design, having five cylinders and producing 55 to 60 tons paper per day. The cylinder machine operates on bleached stock.

11. Raw Materials

The pulp mill has an annual consumption of approximately 200,000 cords of small pine pulpwood derived from topping saw-log trees and from woods-thinning operations. This wood is 100 per cent southern pine, composed of short-leaf and loblolly.

12. Products

The final products are bag and wrapping paper, and bleached and unbleached board.

13. Production

Average pulp production in 1948 was 305.36 tons per day. The pulp mill was originally rated at 150 tons per day. One ton of pulp requires approximately 1.75 cords of wood, a cord of wood weighing 3,000 pounds. This gives a pulp yield, dry solids basis, of 45 to 50 per cent.

Expressed on a dry solids basis, the following production values represent normal operations for present equipment:

Pulp mill	280	tons per day
Fourdrinier machine	193	" " "
Cylinder machine	47	" " "
Log pulp	30	" " "

It was reported that approximately 150 pounds of soap is recovered for each ton of pulp produced. It may be possible to increase this recovery to 160 pounds per ton of pulp. Turpentine recovered amounts to 2 gallons per ton of pulp, with a range between 1.4 and 2.7 gallons.

14. Operations

The mill operates 6-2/3 days per week.

15. Employees

Crossett Paper Mills employ approximately 740 people. Crossett Lumber Co. was said to employ approximately 1800 persons.

16. Water Supply

Ground water is provided by 14 wells having an average depth of 176 feet. Pulp and paper mill requirements were stated to vary between 9,000,000 and 10,000,000 gallons per day.

17. Black Liquor Recovery

Efficiency in recovery of chemicals from the black liquor can be estimated from the amount of sodium sulfate (salt cake) which must be added as make-up in the cooking liquor. Sodium sulfate consumption for 1945 averaged 338 pounds per ton pulp. In 1948 salt cake consumption was reduced to an average of 212 pounds per ton pulp. Sodium sulfate losses for February, 1949 were reported as 141 pounds per ton.

In connection with recovery of chemicals, it was pointed out that 30 to 40 pounds sodium sulfate remain in each ton of pulp. Another 20 pounds salt cake per ton is discharged up the stack of the furnace. Cottrell precipitators have been installed on the furnace stacks for recovery of chemicals from the stack gases. It was stated that 40 pounds sodium sulfate per ton of pulp was the economic limit for salt cake in the waste water. Improvements in the black liquor recovery system are expected to reduce salt cake consumption another 30 to 50 pounds per ton of pulp.

18. By-products

By-products include soap, which is the source of tall oil, a black, sticky, viscous liquid, composed mainly of resin acids, fatty acids, and methanol. Tall oil was desired during the war for use in manufacture of soaps and greases and in the preparation of emulsions. The soap is extracted from the partially evaporated black liquor by removing it from the second-stage evaporator, extracting the soap, and returning the remaining liquor to the third-stage evaporator. In the absence of a demand for tall oil, the soap is currently being burned to recover the soda ash. It was estimated that 75 per cent of the soap was recovered.

Turpentine is being extracted from the digester relief gases.

19. Residual Process Wastes

It was reported that the present evaporator capacity was sufficient for concentration of the black liquor and a small amount of diffuser wash. Presumably the charge to the evaporator is composed of 85 per cent black liquor and 15 per cent diffuser water. Diffuser wash water now approximates 1,800,000 gallons per day. This means that a substantial amount of the diffuser wash water is currently discharged to the process sewers.

Accurate information was not available on water requirements in washing of pulp and bleaching operations. The Fourdrinier machine was stated to use approximately 700 g.p.m. water. The cylinder machine uses somewhat more water than the Fourdrinier. White water from the paper machines passes through save-alls of the type using sweetening stock to form a filter mat through which the white water is filtered.

Digester liquor has a 5-day biochemical oxygen demand which varies between 20,000 and 30,000 parts per million. This liquor is not wasted to the sewer other than through unavoidable leaks. Diffuser wash water 5-day B.O.D. varies between 500 and 1500 parts per million. The most of this diffuser wash water is presently discharged to the sewers. Liquid wastes from the bleach plant were said to contain as much as 6 tons per day dissolved solids. Accurate data were not available on fiber losses from the paper machines, but this may run as high as 4 tons per day.

20. Expansion Program

A program is under way for increasing the output of this pulp and paper mill. Three new digesters were installed in November, 1948. It is proposed to increase eventually pulp production about 23 per cent, which will mean a daily output of 375 tons. A new paper machine is to replace the obsolete cylinder machine. It is understood that the contemplated expansion will adequately handle available wood pulp from present timber holdings.

21. Improvements Affecting Wastes

A number of improvements and changes in plant operations are scheduled which will have definite bearing on the pollutional wastes discharged from this mill. A brief description of each improvement follows.

Order was placed in March, 1949, for a new quintuple-effect evaporator

which will increase evaporation capacity 120 per cent. This equipment is scheduled for delivery in 9 months and should be installed by January, 1950. This new evaporator will be used to concentrate approximately 750,000 gallons per day of the most concentrated diffuser wash water. It was estimated that this new equipment will recover all of the chemicals economically possible.

A new four-stage vacuum washer is being designed for brown stock. This improved washer, which employs the counter-flow principle, will make possible supplying more concentrated weak black liquor to the new quintuple-effect evaporator. The new washer system should be in operation early in 1950.

A new smelting furnace (recovery boiler) will be erected during the summer of 1949. This furnace should be in operation the latter part of 1949. This unit is a necessary addition for more complete recovery of chemicals from the black liquor.

The bleach plant is scheduled to suspend operations late in 1949 and will be out of service for an indefinite period. This bleach plant is to be replaced by a more modern plant at a future date.

Extensive improvements and revisions are being made to the caustic room. The present equipment in the caustic room is either obsolete or worn out. This improvement is included as one which may further remove pollutional wastes from this mill. Further information on improvements is given in Crossett Paper Mills letter report dated April 4, 1949, Appendix "F."

Wood Distillation Plant

22. Plant Description

This plant's facilities include a wood-drying yard, a battery of 10 retorts for the manufacture of charcoal, and a still-house for the manufacture of condensed acetic acid, methanol, chemical oil, and other products.

23. Raw Materials

This chemical plant consumes daily 100 cords of hardwood waste resulting largely from logging and improvement-thinning of standing timber.

24. Products

The principal products include charcoal, acetic acid, methanol, creosote oils.

25. Production

Charcoal, 50 tons per day; acetic acid, 115 pounds per cord; methanol, 10 gallons per cord.

26. Water Supply

This plant uses 250,000 gallons per day water, which is a portion of the pumpage from 5 wells. The remainder of the supply from these 5 wells goes to the sawmills and the City of Crossett.

27. Process Wastes

Data were not available for the characteristics of wastes discharged from this plant. It was reported that the still waste, amounting to 20,000 G.P.D., contained 0.05 per cent acetic acid.

28. Waste Disposal

Wastes from the chemical plant are discharged without treatment through a separate sewer outlet to Coffee Creek, entering the stream in the first mile below the mill sewer outlet.

Coffee Creek

29. General Description

Discharge from this pulp and paper mill enters a branch of Coffee Creek. Coffee Creek flows through inaccessible timber area for a distance of some 14 miles, entering Ouachita River approximately one mile below Dam No. 6 and 1-1/4 miles above the Arkansas-Louisiana state line. There is considerable

fall in this stream in the first 10 miles, the difference in elevation being some 70 to 80 feet. The lower section of Coffee Creek drains through Mossy Lake which provides an estimated retention of 3 to 5 days for the pulp and paper mill wastes. The upper section of Coffee Creek was said to have numerous obstructions, which invites reaeration.

30. Data Reported

Samples were collected during the period September 17 to 20, 1946, from the paper mill sewer and at three points in Coffee Creek. In addition, samples were taken in Ouachita River immediately above and below confluence with Coffee Creek. The location of sampling points and the results for these samples are tabulated below:

	5 Day B.O.D. p.p.m.	Pounds B.O.D. per day	Settleable Solids %
Paper Mill Sewer	500	35,400	
1 Mile Below Mill	428	42,800	3.0
2 1/2 Miles Below Mill	360	36,000	2.0
Discharge to River	80	8,000	> 0.5
River Above	2		
River Below	2		

The flow in Ouachita River at Camden, Arkansas, varied from 656 c.f.s. September 17 to 572 c.f.s. September 20, 1946. Results reported in the table above indicate a reduction in pounds 5-day B.O.D. of approximately 81 per cent. This value should be checked. The increase in pounds 5-day B.O.D. one mile below the mill is attributed to wastes discharged from the wood distillation plant between the paper mill sewer outlet and the second sampling point.

31. Mossy Lake

Mossy Lake is owned by Bradley Lumber Company, Warren, Arkansas. Attempt has been made to utilize Mossy Lake for storage treatment of the pulp and paper mill wastes. Cognizance has been taken of the natural purification occurring during a short storage period. Prior to the fall of 1946, wastes were released from Mossy Lake to Ouachita River only during 12 hours out of each 24-hour period. This procedure placed twice the pollution load on the stream. This practice has been discontinued and the discharge is now continuous.

Ouachita River

32. Drainage Area

Ouachita River is a tributary of Mississippi River, flowing in a south-southeasterly direction. The drainage basin above Cold Spring Bar near Camden, Arkansas, has been computed by the Corps of Engineers as 5390 square miles. The drainage area above Monroe, Louisiana, is given as 15,400 square miles.

33. Gaging Stations

The Corps of Engineers maintains gaging stations on Ouachita River at Monroe, Louisiana, and Cold Spring Bar, Arkansas. Stream flow data have been made available for the station at Monroe, Louisiana, for the period January 1, 1935, to December 31, 1945. Flow data for this stream at Cold Spring Bar are available for the period October 1, 1934, to September 30, 1946.

34. Minimum Flow

Relatively low flows occur in Ouachita River normally during late summer and early fall. The flow seldom goes lower than 250 c.f.s., although four days occurred in September, 1943, when the average discharge dropped to 125 c.f.s. at Cold Spring Bar, Arkansas. The next lowest flow recorded for Ouachita River at Cold Spring Bar was August 6, 1936, when the flow was reported as 240 c.f.s.

Minimum daily low flows for each month during the 12-year period 1935-1946 inclusive are tabulated for Ouachita River at Cold Spring Bar, Arkansas, and included as Appendix G-1. A similar table for Ouachita River at Monroe, Louisiana, is given in Appendix G-2. These are the closest gaging stations to confluence with Coffee Creek.

35. Proposed Dams

Two dams are included in Ouachita River flood control improvements. The Corps of Engineers representative reported that these dams were scheduled for completion as follows:

Narrows Reservoir, 1951

Blakeley Mountain Dam, 1954.

It is believed that the Narrows Reservoir, when completed, will make possible holding the minimum discharge in Ouachita River in the Camden area to approximately 1000 c.f.s. The second reservoir should increase the minimum to about 1600 c.f.s.

36. Natural Purification Studies Proposed

A program has been formulated for study, during the spring and summer of 1949, of liquid wastes discharged from the Crossett Pulp & Paper mill and the wood distillation plant, together with natural purification studies in Coffee Creek and Mossy Lake. These data will provide necessary information for accurately controlling release of wastes from Mossy Lake during critical periods when Ouachita River discharge is low enough to result in serious oxygen depletion.

Research by National Council

37. Annual Report

The National Council for Stream Improvement, Inc., 271 Madison Avenue, New York 16, New York has a research project underway at Louisiana State University. The follow

city. The following is taken from the 1946 National Council Annual Report, pages 16 and 17.

"This project has completed its second year of activity, active work having began in December 1946 at the Engineering Experiment Station, Louisiana State University, Baton Rouge, Louisiana. The project is under the direction of Mr. William A. Maggio who has been designated as the Council's Resident Engineer. Cooperating in this work is Dr. Arthur R. Colmer, Associate Professor, Dept. of Bacteriology. The Research and Statistics Division of the Louisiana Dept. of Wildlife and Fisheries is also cooperating to the extent of making laboratory space and some specialized equipment available.

"The basic requirement of this research project is the comprehensive study of the storage oxidation process to determine the basic mechanics of it as used successfully in several large scale installations in the treatment of liquid wastes from the kraft pulping process. Following the determination of the basic mechanics of the process, efforts are now being directed toward improving the efficiency of the treatment process.

"It has been determined that the storage process of kraft mill waste treatment, as presently used, is predominantly a biological oxidation process. Direct chemical oxidation of the waste products takes place simultaneously but to a very limited extent. The biological oxidation occurs under two environments; aerobic and anaerobic. The anaerobic phase predominates initially and is followed by an aerobic phase of longer duration. The shorter the duration of the anaerobic phase the greater is the efficiency of the B.O.D. removal from the waste.

"Various factors have been studied in the experiments directed toward increasing the efficiency of the storage treatment process. Addition of

bacterial seed, nitrates, ammonia in the presence of phosphates and magnesium, pH adjustment, and waste dilution, either singly or in combination with each other have been instrumental in increasing the B.O.D. removal from the waste. Concurrent with these determinations bacteriological determinations are being made of bacteria populations and identifications. Pure colony cultures are also being studied for their effect on B.O.D. removal from kraft mill waste.

"Due to greatly improved pulp washing systems in the mills, resulting in a weaker type of kraft waste, efforts are being directed toward treatment of the total mill waste rather than toward stronger, segregated, specially selected wastes from the mills. However, the possibility of treatment of specially segregated wastes has not been overlooked. One mill is completing the construction of a pilot plant which will be devoted to the study of chemical treatment of kraft wastes and bleachery waste in particular. Council personnel from this project will assist in the operation and studies carried on at this pilot plant. Laboratory studies have indicated the feasibility of treating kraft bleachery wastes with lime followed by carbonation, sedimentation, dewatering and recovery of the lime by calcining in the plant lime kiln.

"Utilization of the treated waste following storage or chemical treatment is also being investigated. One source of utilization is the reuse of this material as a diluent for fresh mill waste by means of recirculation, prior to the discharge of the waste to storage treatment basins. The further treatment, following storage of this material, using some standard water treatment process may result in a product which could be reused as process water in the mill. This is particularly attractive in view of the alarming decrease in the supply of natural ground waters and the increasing difficulty in treating surface water supplies for use as process waters in Southern pulp and paper

mills.

"Project personnel has also been active in rendering direct mill service to member mills on stream pollution problems, as well as in the organization and execution of mill loss surveys."

Summary

The program under way for improvements inside the pulp mill show promise of substantially reducing the pollution load on Ouachita River from the Crossett, Arkansas, area. It has been estimated that 90 per cent of the 5-day B.O.D. in the mill effluent originates at the pulp mill. During unusually low flow in Ouachita River, prior to completion of mill improvements and dam construction, it is conceivable that fish destruction in Ouachita River below Coffee Creek could be prevented by controlled release of the discharge from Mossy Lake. Data from scheduled waste and stream studies should provide basis for determining the rate at which these partially purified wastes can be safely released during critical stream discharge.

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APPENDIX A

Participants at Conference
Crossett Paper Mills
Crossett, Arkansas
March 30, 1949

W. A. Moggio, Resident Engineer
National Council for Stream Improvement
Engineering Experiment Station
Louisiana State University
Baton Rouge, Louisiana

Hayse H. Black, Sanitary Engineer
U. S. Public Health Service
Environmental Health Center
Cincinnati 2, Ohio

P. E. Cunningham, Engineer
District Office, Corps of Engineers
Vicksburg, Mississippi

R. C. Haws, Sanitary Engineer
Little Rock, Arkansas

F. L. McDonald, Arkansas State Board of Health
Little Rock, Arkansas

J. C. Hair, Production Manager
Crossett Paper Mills
Crossett, Arkansas

K. O. Elderkin, Manager
Crossett Paper Mills
Crossett, Arkansas

C. W. Smith, Plant Engineer
Crossett Paper Mills
Crossett, Arkansas

W. B. Bowers
Agent, Louisiana Stream Control Commission
Baton Rouge, Louisiana

K. G. Chesley, Director of Research
Crossett Lumber Company
Crossett, Arkansas

Travis S. Roberts, U. S. Fish and Wildlife Service
Vicksburg, Mississippi

Harold D. Fields, U. S. Fish and Wildlife Service
Vicksburg, Mississippi

Frank J. Coogan, Technical Advisor
Louisiana Stream Control Commission
Baton Rouge, Louisiana

Paul Sullins, Resident Counsel
Crossett Companies
Crossett, Arkansas

M. E. Moore, Jr.
Fish Management Section
Arkansas Game & Fish Commission
Little Rock, Arkansas

David J. Maclay, Biologist
Mississippi River Commission
U. S. Corps of Engineers
Vicksburg, Mississippi

Bruce Crawford, Fish Management Section
Arkansas Game & Fish Commission
Little Rock, Arkansas

Joe Hogan
Arkansas Game & Fish Commission
Lonoke, Arkansas

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APPENDIX B-1

Farmerville, Louisiana
June 17, 1946

The Hon. Secretary of War,
War Department,
Washington, D. C.

Dear Sir:

The writer of this letter represents approximately 75 land owners, tax payers, property owners, commercial fishermen and sportsmen, who are protesting against the flowing and draining of poisonous chemicals down the Ouachita River and over tributaries, by and on the part of the Crossett Paper Mill of Crossett, Arkansas, and asks for your cooperation and assistance in this matter.

Cattle pasturage, fish, nets and equipment, and timber have been impaired and destroyed in both Louisiana and Arkansas and several hundred citizens of both states have been damaged thereby.

The writer of this letter was a former Federal Executive in the Department of Justice for five years and recalls that agents and engineers of the War Department assisted in a similar investigation where the Springhill Paper Mill had allowed and caused thousands and thousands of barrels of chemicals and poison to be spread over the waters of Lake Bistono, Dorchect and Bodcaw, and it is the recollection of the writer that where one stream empties into another and the other empties into a navigable river such as the Red, Ouachita and Mississippi Rivers, that your department has jurisdiction to investigation and in the name of hundreds of citizens affected in Louisiana and Arkansas, I am asking for an investigation of this matter and for such relief as the Government can give us in the premises.

Asking your consideration of this matter, I am

Yours very truly,

HARVEY G. FIELDS,
Attorney at Law.

HGF:olh

COPY

APPENDIX B-2

Farmerville, Louisiana
October 4th, 1948

Mr. Ernest C. Clements, Commissioner
New Orleans, Louisiana

Dear Sir:

The committee of citizens from Union Parish were glad to receive your letter of two weeks ago that the Stream Council Commission would give its assistance to stopping the paper mill at Crossett from emptying poisonous waters into the Ouachita River in Louisiana, as they carefully arrange for it to come into the river at the line, but up to now nothing has been done, even though the Stream Council Commission says that the paper mill had agreed with the State and the Government to stop it, because on Friday night the committee sent a man to the place where it comes in on the state line and it was worse than ever.

Senator Ellender has taken the matter up with the War Department previously and they first claimed that they had no jurisdiction but right after that Mr. Truman signed a bill under which either the War Department or the Surgeon General and the Government could proceed if they wanted to and could help the state authorities.

One hundred citizens in Louisiana have appealed to the Government but without avail to date, and we are now writing to ask you if you could ask the Stream Council Commission to take the matter up with the proper departments in Washington.

Thanking you in advance, I am

Yours respectfully,

(S) HARVEY G. FIELDS

Harvey G. Fields
Attorney for Union Parish
Citizens Committee

cc/
War Department, Washington, D. C.
Pres. Harry S. Truman, Washington, D.C.
U. S. Senator Allen Ellender, Washington, D. C.
Stream Council Commission

COPY

APPENDIX D-1

WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DIVISION ENGINEER
LOWER MISSISSIPPI VALLEY DIVISION
VICKSBURG, MISSISSIPPI

ADDRESS REPLY TO:

Office of the Division Engineer
Lower Mississippi Valley Div.
Corps of Engineers
P. O. Box 80
Vicksburg, Mississippi

19 Nov. 1948

REFER TO FILE NO. LMVKD

Federal Security Agency
Public Health Service
Washington 25, D.C.

Attention: Mr. Carl E. Schwob

Dear Sir:

Reference is made to your 3 November 1948 letter in which you advised of recent correspondence between the Chief of Engineers and Mr. Harvey C. Fields, Farmerville, Louisiana, concerning pollution of the Ouachita River being referred to your office for consideration and requested a copy of our previous reports dealing with that subject.

The matter of pollution of the Ouachita River from the waste discharge of the Crossett, Arkansas, paper mill was investigated in September 1944 along with the paper mills at Camden, Arkansas, and Monroe and Bastrop, Louisiana, in response to a complaint from Mr. V. E. Claunch, Caldwell Parish, Louisiana. The report of the District Engineer, Vicksburg, dated 30 September 1944, covering his investigation of conditions at that time is attached as Inclosure No. 1.

The matter of pollution of the Ouachita River from the waste discharge of the Crossett, Arkansas paper mill was again investigated by the District Engineer, Vicksburg, Mississippi, in June 1945, in response to a complaint from Mr. W. L. Mattison, Bastrop, Louisiana. A copy of the District Engineer, Vicksburg's report on his findings at the time of his investigation of that complaint are contained in his 3rd Indorsement, dated 16 June 1945, which is attached as Inclosure No. 2.

Our office has received no complaint of pollution of the Ouachita River as a result of effluent from the paper mill at Crossett, Arkansas, in the interim between the June 1945 and 15 October 1948 complaints. Our office has not made an investigation of this later complaint.

FOR THE DIVISION ENGINEER:

Very truly yours,

2 Incls:
1. 3rd Ind dtd 30 Sept 44
2. 3rd Ind dtd 16 June 45

WILLIAM F. CASSIDY
Lt. Colonel, Corps of Engineers
Assistant

COPY APPENDIX D-2

LMVKM 800.224(Ouachita R.) 3d Ind.

U.S.Engineer Office, Vicksburg, Miss., 30 September 1944

TO: The Chief of Engineers, U.S.Army, Washington 25, D.C.

Through: The Division Engineer, L.M.V.D., Vicksburg, Miss.

1. Pollution of Ouachita River in recent years has been caused by discharge of effluent from paper mills at Camden and Crossett, Ark., and Monroe and Bastrop, La. Oil pollution comes from the oil fields in the El Dorado area and reaches Ouachita River through Smackover Creek. The oil pollution affects Lock and Dam No. 8, but seldom reaches downstream as far as Lock and Dam No. 6. Several years ago the discharge of oil and salt water into Ouachita River was heavy, but in the past few years it has been negligible.

2. The mill at Camden, Ark., stores the effluent and discharges it only during periods of high water. This office has received no complaints in recent years regarding pollution from this source.

3. The mill at Crossett, Ark., stores the effluent in Mossy Lake, and likewise discharges it only during periods of highwater. At the lower end of Mossy Lake an earth dam with spillway and control gates has been constructed across Coffee Creek. The effluent from the mill passes through Coffee Creek to Mossy Lake, where it is stored until discharged during highwater periods into the lower stretch of Coffee Creek, through which it passes into Ouachita River about 3,000 feet below Lock and Dam No. 6. Due to the fact that minnows are plentiful at the mouth of Coffee Creek during low water periods, it is evident that the pollution at these times is negligible. A check was made during the low water period in August as to dead fish at Lock and Dam No. 5, at Sterlington, the first dam below where the effluent from the mill could reach the river; and at Locks and Dams Nos. 4 and 3. No dead fish were observed at any of these dams at that time. If any appreciable amount of effluent had been discharged from the Crossett mill during this time it would have affected the fish at Lock and Dam No. 5.

4. The paper mill at Bastrop, La., is now using a new process, which it is believed will correct the problem of pollution of Bayou La Fourche.

5. The paper mill at Monroe, La., changed its process in 1941. Since that time pollution conditions have improved at least 75 per cent.

6. There is, nevertheless, a real basis for concern over the destruction of fish and other wild life in Ouachita River, occasioned by the operation of the paper mills in its vicinity. Other investigations and reports have been made in the past. Reference is made to letter from the Chief of Engineers, dated 26 March 1937, file 7235 (Ouachita River)-10, to Senator Joe T. Robinson, of Arkansas, wherein a report was made on the results of an investigation made at that time by this office. Senator Robinson was advised that while the War Department administers the laws enacted by Congress prohibiting the discharge of refuse matter of any kind or description whatever

other than that flowing from streets or sewers and passing therefrom in a liquid state into any navigable water, or tributary thereof from which the same shall float or be washed into such navigable water of the United States, action by the Department is limited to the preventing of obstructions and danger to navigation, and is not taken alone for the safeguarding of public health or fish life, or the recreational use of the water. No complaints have been received by this office from navigation interests in recent years.

R.W. Sauer
Lt. Col., Corps of Engineers
District Engineer

Incls:
n/c/
Withdrawn: Copy of Incl.
for Dist. Engr.

APPENDIX D-3

COPY

LMVKM 600.224(Ouachita R.) 3d Ind.

U.S. Engineer Office, Vicksburg, Miss., 16 June 1945

To: The Chief of Engineers, U.S. Army, Washington, D.C.

Through: The Division Engineer, L.M.V.D., Vicksburg, Miss.

1. Investigation has been made of the complaint outlined in basic letter.

2. Mr. Mattison was interviewed at Bastrop, La., and the pollution of the Ouachita River by the Crossett Paper Mill at Crossett, Ark., was discussed with him. He was advised that the Lockmasters of each lock and dam on the Ouachita River have instructions to report promptly the presence of any dead fish observed at the dams. No dead fish have been observed at the dams since report was made by this office by third indorsement dated 30 September 1944, File CE SPEMR, on a similar complaint.

3. No complaints have been received from navigation interests that the discharge of paper mill waste affects navigation.

4. In reference to the action by the United States in the District Court of the United States for the Eastern District of Michigan, Southern Division, against the Consolidated Paper Company and the River Raisin Paper Company, cited in paragraph 2 of 1st Ind., Office, C. of E., dated 19 May 1945, decision was rendered on the basis of the fact that navigation was being impeded and obstructed, thereby making applicable Section 13 of the River and Harbor Act of 3 March 1899.

5. Since the waste from the paper mills discharged into the Ouachita River does not impede or obstruct navigation, it appears that the War Department has no basis for action at this time under provisions of the aforementioned River and Harbor Act.

R.W. Sauer
Lt. Col., Corps of Engineers
District Engineer

1 Incl.
Ltr 3 May 45 from Mr. Mattison.
(other inclosure withdrawn)

APPENDIX E - SUMMARY OF TESTIMONIALS

Brief statements were made by commercial fisherman and residents of Union Parish at a meeting called at Farmersville, La., by Attorney Harvey Fields, March 31, 1949. Following is a record of this testimony:

Walter S. Smith

Mr. Smith resides on Rural Route 3, Marion, Louisiana. He has been a resident of this locality for some 25 years. He is a commercial fisherman and has fished on Ouachita River in the vicinity of Alabama Landing for the past 12 years. Mr. Smith was a member of the committee who retained Attorney Fields in an effort to obtain relief from pollution responsible for fish destruction in Ouachita River.

Mr. Smith testified that fish were destroyed by the thousands in the late spring and early summer of 1948. These fish included cat, buffalo, bass, perch, and gar. This destruction of fish occurred when Ouachita River was at medium stage but rising. Many of these fish were seen floating in the 5-6 acre backwater area opposite Alabama Landing. Decomposition of the dead fish resulted in highly offensive odors. Mr. Smith fishes almost daily. He reports seeing the dead fish in the early fall of 1948.

L. M. Powell

Mr. Powell is a game warden and large landowner in Union Parish in the vicinity of Alabama Landing. This witness reported observing fish gaping for air in the backwater opposite Alabama Landing. He advised that he caught a number of these fish and gave them to negroes. He expressed the opinion that conditions had improved, but also stated that fish did not spawn in these polluted waters.

David Hollis

This witness has been a commercial fisherman since 1939. Mr. Hollis farms in summer but devotes time to fishing during the remainder of the year. He reported catching a good many catfish and buffalo in the spring of 1942, but since that time these species have been virtually absent from Ouachita River in the vicinity of the Arkansas-Louisiana state line.

John Medlin

Mr. Medlin reported gross fish destruction in the vicinity of Alabama Landing during July, 1948. These fish were for the most part collected in the backwater opposite the Landing. There were a good many bass, and most of the fish were large, many as long as 24 inches. He reported having collected a boatload of dead fish and having fed them to hogs.

Judson DeVille

Mr. DeVille lives in a houseboat on the bank of Ouachita River, approximately 1/2 mile north of Alabama Landing. He claimed to be

a cat-fisherman and also a net fisherman. Mr. DeVille has been on the river for approximately 10 years.

This witness reported fish dying in boxes and nets. He contends that objectionable pollution has existed ever since the Crossett Paper Mill started operating in 1937. Minnows are destroyed as well as the larger fish. Nets were reported to deprociate more rapidly in Ouachita River than they do in nonpolluted waters. Mr. DeVille stated that when the water was black from sulphate mill waste, catfish were normally absent.

Calvin Pardue

Mr. Pardue was reported to be one of the oldest fishermen residing in the Marion, La., area. He fishes from November to March each winter. Mr. Pardue reported conditions to be worst in Ouachita River during the 4-year period 1942-1946.

Robert Day

Mr. Day reported that outlet dams from Mossy Lake were operated to give intermittent discharge of stored pulp mill wastes. This statement confirms report by Crossett Paper Mill Co. officials.

One local fisherman, whose name was not recorded, reported being allergic to sulphate mill wastes, even when diluted by river water. This allergy was in the form of dermatitis.

COPY APPENDIX V

CROSSETT PAPER MILLS

Division of Crossett Lumber Company
Crossett, Arkansas

April 4, 1949

Mr. Hayes H. Black, Sanitary Engineer
U. S. Public Health Service
Environmental Health Center
Cincinnati 2, Ohio

Dear Mr. Black:

In accordance with your request I am giving you herewith a resume' of the progress made at this mill in reducing mill waste since the war and an outline of our plans for the future.

During the war our principle efforts at this mill were directed at getting out production and with the handicaps that we operated under in the way of shortage of materials et cetera, no capital expenditures were made which would have improved our recovery system. However, as soon as the war was over and materials available, we began to make improvements to our process which have, we think, tremendously improved our position.

The salt cake consumption of a mill is a pretty good indicator of the amount of waste which is going out of that mill. It is the chemical waste which we worry about in considering stream pollution and the amount of makeup of chemicals required to keep our system in balance is a pretty good indicator of what is going down the sewer. Here let me remind you that our mill waste travels 14 miles before it enters the Ouachita River.

During 1945, which was the last war year, our average salt cake consumption for the year was 338 lbs. per ton. In 1948 we had reduced this to an average for the year of 212 lbs. per ton. For the last month for which we have any record, that is February 1949, our losses were 141 lbs. per ton.

During the war years much of our soap went down the sewer because we had no means of reclaiming it. In 1945 we installed a soap extraction plant which now takes out about 150 lbs. of soap for every ton of pulp we make. Since the soap has been considered by the authorities to be the most toxic part of our effluent, and since we are now removing this material, we undoubtedly have improved our sewer conditions.

We are now also extracting about 2 gallons per ton of turpentine, which originally went down the sewer. We do not know what the effect of turpentine was, but we are pretty sure that it did not do any good.

Last fall we adopted the policy of letting our mill sewage run into the Ouachita River at a uniform rate whereas previously it had been run into the river at only 12 hour periods each day. We believe that this last move has contributed a great deal towards reducing the possibility of stream pollution.

I will now outline some of our plans for the future. In March of this year we ordered a new evaporator set which will increase our evaporation capacity 120%. This equipment is scheduled for delivery in 9 months from the date of placing the order which means that it should be in service inside of 12 months. With this equipment all of the weak black liquor will be recovered which is economically possible.

The Rust Engineering Company of Pittsburgh are now in the process of designing a new four stage vacuum washer system for our brown stock and we expect to have this in operation sometime in 1950. This will further reduce the amount of black liquor which gets into the sewer.

The steel work for our new recovery boiler is scheduled for delivery in May 1949 and the erection of the boiler proper is scheduled for September 1949 so that it should be in operation about the end of this year. This will contribute to further improvement.

The Rust Engineering Company are now busy laying out extensive revisions to our Caustic Room which should come into operation late in 1950.

We estimate that these improvements will lower our salt cake consumption to less than 100 lbs. per ton of pulp.

The new equipment which we are installing is the most modern available and will make this mill as efficient in its black liquor recovery system as any kraft mill that we know of.

Our average pulp production in 1948 was 305.36 tons per day. After the above mentioned extensions and improvements are completed we expect to average about 375 tons per day.

Present plans call for our Bleach Plant to go out of service at the end of this year for an indetermined period of at least several

years. In fact the present plant will never go back into service but will probably be replaced at some future date by a more modern bleach plant.

To summarize - during the last war year our salt cake consumption was 338 lbs. per ton. It is now about 141 lbs. based on last month's record and we expect to get it down to under 100 lbs. At the same time we expect that our pulp production at this plant will increase about 23%. Actually the improvement in sewage losses is greater than is shown by these figures because of the fact that a certain percentage of our soda losses do not reach the sewer at all, but go up into the atmosphere or out with the paper. The percentage of decrease in the amount of waste going to the sewer has therefore, been considerably greater than would be indicated by the above figures. Our position is, therefore, that we have already improved our sewage disposal system to a considerable extent and are planning to put into effect all those improvements which are economically possible and we are going ahead with those improvements as fast as our finances will allow. The above improvements will total well over $5,000,000. By the Summer of 1950, most of the above improvements will be completed.

By 1951 the first dam on the Ouachita River should be completed which it is said will hold the minimum discharge at about 1000 cu. ft. per second and this should preclude the possibility of any damage to fish because the dilution will be sufficiently great for all practical purposes.

We are going ahead with the collection of data on stream flow, b.o.d., dissolved oxygen et cetera, as soon as water conditions permit. I think the above will indicate that we are doing all that is economically feasible to improve the sewage conditions at this mill and we fully believe that by the year 1951 there will be no possibility of our effluent from this mill creating any nuisance whatsoever.

If there is any further information we can give you do not hesitate to let us know and we will be very glad to cooperate in any way possible.

Yours very truly,

CROSSETT PAPER MILLS

/s/ K. O. Elderkin

K. O. Elderkin
Manager

KOE:LR

OUACHITA RIVER: DAILY LOW FLOWS AT CAMDEN AND COLD SPRING BAR, ARKANSAS

Year	Month	Day	Min. CF s.f.s.	Year	Month	Day	Min. CF s.f.s.
1934	Oct.	31	355	1938	Dec.	21	910
	Nov.	1	305	1939	Jan.	3	2090
	Dec.	15-16	3200		Feb.	1	14500
1935	Jan.	15	4460		Mar.	25	3120
	Feb.	25-26	5440		Apr.	30	11000
	Mar.	4	4740		May	17	1440
	Apr.	5	5240		June	21	860
	May	29	6460		July	17-18,22,23, 25-26	420
	June	30	6240		Aug.	9-10	330
	July	28 & 31	490		Sept.	20	525
	Aug.	7,12-13	330		Oct.	28	345
	Sept.	13 & 20	520		Nov.	29	390
	Oct.	6 & 9	910		Dec.	13	525
	Nov.	30	3260	1940	Jan.	10	490
	Dec.	1-2	3190		Feb.	1	595
1936	Jan.	30-31	1110		Mar.	6,12,26-28	1110
	Feb.	24	860		Apr.	3	1500
	Mar.	23	1440		May	18	2150
	Apr.	22	1060		June	28	1050
	May	28 & 31	560		July	19	1280
	June	28, 29, 30	300		Aug.	28	720
	July	1, 2, 19	300		Sept.	19	405
	Aug.	6	240		Oct.	3	360
	Sept.	28	270		Nov.	20	960
	Oct.	22-23	300		Dec.	7	5330
	Nov.	25	765	1941	Jan.	15, 22	3060
	Dec.	2	675		Feb.	19	4730
1937	Jan.	1	6070		Mar.	31	3740
	Feb.	18	4230		Apr.	1	3530
	Mar.	23-24	5450		May	29, 30	1010
	Apr.	21	2220		June	1-2	1110
	May	31	1110		July	8, 11-12	765
	June	3-4	810		Aug.	26,27,28	315
	July	29	360		Sept.	4-5	455
	Aug.	16-17	285		Oct.	7	2660
	Sept.	23	420		Nov.	19	2560
	Oct.	13	595		Dec.	10	2280
	Nov.	6	595	1942	Jan.	26	2280
	Dec.	16	1330		Feb.	16	5320
1938	Jan.	18	2660		Mar.	25	4630
	Feb.	14-15	5910		Apr.	7	4400
	Mar.	9	5910		May	31	2500
	Apr.	30	7410		June	10	1080
	May	13	1500		July	22	530
	June	10	1160		Aug.	16	440
	July	18-19	455		Sept.	30	595
	Aug.	25 & 31	360		Oct.	29	519
	Sept.	23-24	330		Nov.	4-5	1460
	Oct.	25	330		Dec.	2,23	1760
	Nov.	2-3	405	1943	Jan.	26	3020

OUACHITA RIVER: DAILY LOW FLOWS AT CALHOUN AND COLD SPRING BAR, ARKANSAS

Year	Month	Day	Min. c.f.s.
1943	Feb.	26	2000
	Mar.	2	1760
	Apr.	13	3440
	May	8	2600
	June	30	1400
	July	6	555
	Aug.	27-28	175
	Sept.	16,24,25,26	125
	Oct.	1	156
	Nov.	24,25,26,30	259
	Dec.	1	259
1944	Jan.	1,2,3	2360
	Feb.	8	3280
	Mar.	16	6200
	Apr.	21	3500
	May	30	5180
	June	27-28	1110
	July	26	328
	Aug.	22-23	357
	Sept.	20-21	333
	Oct.	13	232
	Nov.	2	433
	Dec.	4-5	392
1945	Jan.	31	3360
	Feb.	12	2000
	Mar.	30	31700
	Apr.	22	9700
	May	9	4130
	June	7,8,9	1540
	July	25	768
	Aug.	14	336
	Sept.	8,12	600
	Oct.	21	1330
	Nov.	7	1380
	Dec.	12	2620
1946	Jan.	3	5750
	Feb.	28	7170
	Mar.	5	3700
	Apr.	16	3500
	May	13	7240
	June	26	1220
	July	6	592
	Aug.	29	600
	Sept.	6	460

OUACHITA RIVER: DAILY LOW FLOWS AT MONROE, LOUISIANA

Year	Month	Day	Min. Q = c.f.s.		Year	Month	Day	Min. Q = c.f.s.	
1935	Jan.	1	15,600		1938	Nov.	-	-	**
	Feb.	28	40,500			Dec.		-	**
	Mar.	27, 28, 29			1939	Jan	4	11,500	*
		30, 31	36,300			Feb.	1	26,000	
	Apr.	10	31,300			Mar.	31	47,200	
	May	1, 2	33,100			Apr.	3	46,600	
	June	30	28,800			May	31	33,400	
	July		-	*		June	24	4,600	*
	Aug.		-	**		July		-	**
	Sept.		-	**		Aug.		-	**
	Oct.		-	*		Sept.		-	**
	Nov.		-	*		Oct.		-	**
	Dec.		-	*		Nov.		-	**
1936	Jan.	29	1,030			Dec.		-	**
	Feb.	26	2,050		1940	Jan.		-	**
	Mar.	27	1,710			Feb.	28	11,200	*
	Apr.	24	2,250			Mar.	28, 31	12,000	*
	May	25	890			Apr.	6	6,500	
	June	4	105			May	24	13,400	
	July	1	670			June	11	8,430	*
	Aug.	14, 15	320			July	1	15,000	
	Sept.	28, 29	310			Aug.	22	3,310	*
	Oct.	21, 22	110			Sept.		-	**
	Nov.	24	350			Oct.		-	**
	Dec.	5	350			Nov.	6	3,300	*
1937	Jan.	2	16,500	*		Dec.	1	19,300	
	Feb.	28	51,300		1941	Jan.	31	23,800	
	Mar.	31	42,000			Feb.	1, 2	23,800	
	Apr.	30	23,800			Mar.	1, 2, 3	27,600	
	May	17, 18	13,700	*		Apr.	28	22,400	
	June		-	**		May	1	23,100	
	July		-	**		June	30	4,120	
	Aug.		-	**		July	12	2,100	
	Sept.		-	**		Aug.	30	559	
	Oct.		-	**		Sept.	1	578	
	Nov.	11	12,600	*		Oct.	10	3,070	
	Dec.	10	12,600	*		Nov.	19	8,060	
1938	Jan.	28	36,200			Dec.	12, 13	5,550	
	Feb.	1	39,100		1942	Jan.	31	5,470	
	Mar.	31	44,200			Feb.	1	6,080	
	Apr.	2, 3	44,000			Mar.	1	15,700	
	May	31	30,800			Apr.	1 thru 8	29,000	
	June	14	7,700	*		May	1	47,700	
	July		-	**		June	30	24,200	
	Aug.		-	**		July	29	1,030	
	Sept.		-	**		Aug.	8	1,070	
	Oct.		-	**		Sept.	5	1,190	

* Part of month flow was at pool stage.
** Flow was at pool stage entire month.

OUACHITA RIVER: DAILY LOW FLOWS AT MONROE, LOUISIANA

Year	Month	Day	Min. Q = c.f.s.	
1942	Oct.	28	929	
	Nov.	16	710	
	Dec.	5	2,030	
1943	Jan.	31	6,430	
	Feb.	14	4,720	
	Mar.	5	4,510	
	Apr.	30	28,100	
	May	20	7,450	
	June	27	2,440	
	July	14	595	
	Aug.	26	509	
	Sept.	5	516	
	Oct.		-	**
	Nov.		-	**
	Dec.		-	**
1944	Jan.	1	3,280	
	Feb.	1	6,100	
	Mar.	1	33,900	
	Apr.	1	45,100	
	May	1	54,100	
	June	30	34,200	
	July	15	2,100	*
	Aug.		-	**
	Sept.		-	**
	Oct.		-	**
	Nov.		-	**
	Dec.	9	7,780	*
1945	Jan.		26,800	
	Feb.		31,500	
	Mar.		39,500	
	Apr.		70,200	
	May		52,000	
	June		38,000	
	July		23,300	
	Aug.	27	4,260	*
	Sept.		-	**
	Oct.	23	4,370	*
	Nov.	5	5,500	*
	Dec.	18, 19	13,400	*

* Part of month flow was at pool stage.
** Flow was at pool stage entire month.